REMARKS

Upon entry of claims 1-4, 6-12, 14-18 and 20 will be pending. Claims 5, 13, and 19 are cancelled without prejudice or disclaimer, and claims 1, 3, 7, 10, 12, 14-18 and 20 are amended. A marked up version showing the proposed changes made by the present amendment is attached hereto as "Version with Markings to Show Changes Made."

Claims 1-20 were rejected under 35 USC §112, first and second paragraphs. It is believed that the proposed amendments overcome the rejections set forth in paragraphs 2 and 4 of the Office Action.

Claims 1, 3-5, 11, 13 and 19 were rejected under 35 USC §102(b) as being anticipated by McKim Jr. et al. Favorable reconsideration of this rejection is earnestly solicited.

McKim et al. discloses contacts 54, 64 fusion welded on the resistor body 50, 60. However, McKim et al. fails to disclose "metal strips of flat tetragonal shape having a same width with a width of the resistor body". According to McKim et al., "the straight current path structure" cannot be obtained by the spot-welded like contact pin structure. Further, trimming and diverging slit 52 corresponds to trimming cutouts formed at right angles to the longitudinal direction of the resistor body to form detour of the current path. Therefore, "the straight and uniform current path structure" of the present invention cannot be obtained by the existence of the contacts 54, 64 and slit 52, 62.

Claims 1, 2, 7 and 9 were rejected under 35 USC §102(a) as being anticipated by Matsuo et al. Favorable reconsideration of this rejection is earnestly solicited.

Matsuo et al. was published on April 21, 2000, after the filing date of April 4, 2000, of priority Japanese Application No. 2000-102616. A verified English language translation of the priority document (JP 2000-102616) is filed herewith to overcome Matsuo et al. as prior art.

Claims 1-4, 6-11, 13, 14, 16-17, 19 and 20 were rejected under 35 USC §102(e) as being anticipated by Szwarc et al. '234, or in the alternative under 35 USC §103(a) as obvious over Szwarc et al. in view of McKim Jr. et al., Hollander or Das et al. Favorable reconsideration of this rejection is earnestly solicited.

Szwarc et al. '234 discloses that copper strips 14 are welded or attached to the opposite sides of resistive strip 12 (see column 2 lines 8-9). Namely, the copper strips are bonded to the side surface of the resistive strip 12. Also, the copper strips have pins 16, which are bent so as to extend substantially perpendicular to the plane of strips for connection to the current source or integrated circuit board (column 2 lines 28-37). Therefore, Szwarc et al. '234 does not disclose "metal strips of flat tetragonal shape are bonded on a surface of the resistor body". Hence, the compact design of the low resistance value resistor cannot be obtained by Szwarc et al. '234, because metal strip electrodes are not superposed on the resistor body but winged out of the resistor body bonded to the opposite side edges of the resistor body 12. Also, the diffusion layer of the present invention cannot be formed in a surface of the resistor body, because metal strip electrodes are not disposed on the surface of the resistor body.

Hollander relates to fabricating a thermocouple cable and the cable resulting therefrom, and discloses that "the edges may be joined by... by diffusion bonding" (column

3 lines 22-25). However, Hollander does not disclose that the metal strip having a same width with the width of the resistor body is bonded to the resistor body by forming a diffusion layer through the electrode. Therefore, it is very difficult to apply the diffusion bonding technology by Hollander to the present invention.

Das et al. relates to a platinum heater for an electrical smoking article, and discloses "diffusion bonding" for fabricating the platinum heater. However, Das et al. also does not disclose that a metal strip having a same width with the width of the resistor body being bonded to the resistor body by forming a diffusion layer through the electrode. Therefore, it is difficult to apply the diffusion bonding technology by Das et al. to the present invention.

Accordingly, the cited references fail to teach or suggest the presently claimed invention.

Claims 1-14, 16, 19 and 20 were rejected under 35 USC §102(b) as anticipated by Szwarc et al. '085, or in the alternative , under 35 USC §103(a) as obvious over Szwarc et al. in view of McKim Jr. et al., Hollander or Das et al. Favorable reconsideration of this rejection is earnestly solicited.

Szwarc et al. '085 discloses a surface mounted four terminal resistor wherein a slot 24 is cut into each of the termination plates (pads 14) so as to form a current pad portion 16 and a sense pad portion 18 (column 2 lines 26-30, Fig. 1). The surface mounted four terminal resistor 10 is formed by welding to each side of the resistive strip 12 with two strips 14, 14 (column 2 lines 30-33). Also, laser trimming is carried out so as to form a cutout at a perpendicular direction to longitudinal direction of resistive strip 12 between electrodes 14, 14 as shown in Fig. 1 (column 2 line 36). The cutout by laser trimming causes a detour

of current flowing path between electrodes 14, 14.

In contrast to the four terminal resistor by Szwarc et al. '085, a four terminal resistor of the present invention comprises two electrodes (metal strips: current pad portion) being disposed on a first surface of the resistor body at both ends thereof and two bonding electrodes (metal strips: sense pad portion) being disposed on a surface opposite to first surface having the electrodes at both ends thereof (claim 7). Also, according to the present invention, a straight and uniform current path is obtained between both electrodes, thus compact and stable current path design of four terminal electrodes can be obtained.

The deficiencies of McKim Jr. et al., Hollander, and Das et al. have been discussed above. Thus, for the same reasons as discussed above, the secondary references fail to provide the teachings which Szwarc et al. '085 lacks.

Claims 1-6, 8-9, 13-19 were rejected under 35 USC §102(e) as anticipated by Gerber et al., or in the alternative, under 35 USC §103(a) as obvious over Gerber et al. in view of McKim Jr. et al., Hollander or Das et al. Favorable reconsideration of this rejection is earnestly solicited.

Gerber et al. discloses a surface mount resistor comprised of an elongated strip of resistive material and conductive terminals formed at both ends of the resistive material. The resistive material is machined with a laser beam to create a current path having a desired resistance. The pattern cut is determined by partitioning the resistive material into a plurality of squares forming a current path through the resistive material with the correct resistivity.

However, conductive terminals 22, 24 are formed by applying a conductive material

over the metallic pads 14, 16, namely by electroplating (column 3 lines 27-32). Further, high conductivity metallic pads 14, 16 are joined to the resistive material 20 at the ends thereof (Fig. 2, and column 3 lines 27-32). That is: the electrodes 22, 24 formed on a surface of the metallic pads 14, 16 are made by conventional technology itself, and the metallic pads 14, 16 are not superposed on the resistive material 20, but joined to the end surfaces of the resistive material 20. Thus, Gerber et al. fails to disclose that metal strips are affixed on a surface of the resistor body by diffusion bonding to form a diffusion layer through the electrode. Also, according to Gerber et al., since metallic pads 14, 16 are not superposed on the resistive material 20, but winged out of the resistive material 20, sufficient bonding strength and uniformity of current distribution cannot be obtained.

Further, according to Gerber et al., the resistive material is machined with a laser beam to create a current path partitioning the resistive material having a desired resistance, that is, Gerber et al. fails to disclose a straight and uniform current path between both electrodes, which have the same width with the width of the resistor body.

The secondary references applied by the examiner fail to provide the teachings which Gerber et al. lacks for the same reasons discussed above.

The problems associated with the prior art and a summary of the present invention are provided below:

Problems of Prior art technology

Plated electrode or Metal strip welded electrode

As to the low resistance value resistor in the prior art technology, electroplating electrodes or metal strip electrodes bonded to the resistor body by welding are generally

used. However, according to such electrodes, uniformity of electric potential (current distribution) through the electrode is low, and the current path cannot be stabilized.

Detour current path in the resistor body

Trimming to adjust a resistance value is generally performed by laser trimming, which forms a cutout at right angles to the longitudinal direction of the resistor body. So, detour of the current flow path in the resistor body is inevitable, thus causing variations in the resistance value in life testing and so on (see "BACKGROUND OF THE INVENTION" in the specification).

Present invention

Diffusion-layer(Diffusion bonded metal strip electrode)

Each of the metal strips having flat tetragonal shape is affixed on the resistor body such that a diffusion layer is formed at an interface between the resistor body and the metal strip or in interior of the resistor body under the metal strip by means of rolling and/or thermal diffusion bonding. Rolling and/or thermal diffusion bonding is carried out by applying heat to maintain a specific temperature and applying pressure. By the diffusion bonding, a diffusion layer is formed by diffusion of the material from the metal strip to the bonding interface or into the interior of the resistor body (see specification page 6 line 5-17). Also, as to the diffusion bonding, please see Experimental Evidence page 5 item 4 (Method of diffusion bonding) in the attached Declaration under 37 C.F.R. §1.132. Because of the presence of the diffusion layer, the electrodes are bonded strongly to the resistor body and the distribution of current in the electrode is uniform. Therefore, a low resistance value resistor of superior electrical properties can be obtained (see specification

page 6 line 18 - page 7 line 2).

Straight and uniform current path

The resistor body is tetragonal shaped, and a pair of electrodes (metal strips) of flat tetragonal shape is affixed on a surface of the resistor body at both ends thereof. The tetragonal shape metal strip (electrode) has a same width with the width of the resistor body and uniform electric potentials through the electrode by the diffusion layer. Thus, a straight and uniform current path is formed in the resistor body, which has the same width with the width of metal strips. The resistor body has no cutout by laser trimming at a perpendicular direction to the longitudinal direction of the resistor body, thus preventing detour of current flow. Therefore current flows straightly and uniformly in the resistor body between both electrodes, and the current flow path is stabilized. Precise trimming for adjusting the resistance value is carried out by removing a portion along the longitudinal direction between the electrodes such that the distribution of the current flow in the resistor body is hardly affected. Thus, after life testing and other tests, the degree of precision of the resistor can be retained (see specification page 3 line 22-page 4 line 16). For example, changes in resistance in no cutouts trimmed resistors can be reduced to a level of (1/several tens) to (1/200) compared with changes that take place in cutouts trimmed resistors (see specification page 13 lines 13-17).

Remarkably decreasing variations in the resistance value

According to the present invention, straight, uniform, and stable current flow in the resistor body can be obtained by a combination of the above structures. Therefore, variations in the resistance value in the life testing and so on, can be decreased

remarkably. The advantages of present invention are experimentally shown in the attached Experimental Evidence with the attached declaration by Mr. Nakamura.

For at least the foregoing reasons, the claimed invention distinguishes over the cited arts and defines patentable subject matter. Favorable reconsideration is earnestly solicited.

Should the examiner deem that any further action by applicants would be desirable to place the application in better condition for allowance, the examiner is encouraged to telephone applicants' undersigned attorney.

In the event this paper is not timely filed, the undersigned hereby petitions for an appropriate extension of time. The fee for this extension may be charged to Deposit Account No. 01-2340, along with any other additional fees which may be required with respect to this paper.

Respectfully submitted,

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PATENT TRADEMARK OFFICE

SGA/nk
Enclosures: Petition for Extension of Time
Verified English Translation of JP 2000-102616
Declaration under 37 CFR §1.132
Version with Markings to Show Changes Made

Serial Number: 09/825,446

Version with Markings to Show Changes Made

1. (Twice Amended) A low resistance value resistor comprising:

a resistor body comprised by a resistive alloy;

at least two electrodes, comprised by metal strips of flat tetragonal shape having a high electrical conductivity, each of said metal strips having a same width with a width of said resistor body, and affixed on one surface of the resistor body separately wherein a diffusion layer is formed at an interface between the resistor body and the metal strip or in an interior of the resistor body under the metal strip; and

a straight and uniform current path formed in the resistor body between said at least two electrodes having uniform electric potentials through the electrode, wherein said current path has a same width with the width of the resistor body and the electrodes ~~formed separately on one surface of the resistor body wherein~~

~~the metal strips are affixed on the resistor body by means of at least one if rolling and thermal diffusion bonding~~.

3. (Twice Amended) A low resistance value resistor according to claim 1, wherein a portion of the resistor body is trimmed by removing a portion of the body material along a direction of current flow between the electrodes to adjust a resistance value so that a direction of the current flow in the trimmed resistor body is hardly affected by removal of said portion ~~without forming any cutout~~.

7. (Twice Amended) A low resistance value resistor according to claim 1, wherein

said at least two electrodes are disposed at both ends of a first surface of the resistor body, and two bonding ~~second~~ electrodes are disposed at both ends of a surface opposite to the first surface having the electrodes.

10. (Twice Amended) A low resistance value resistor according to claim 7, wherein a resistivity of the electrode comprised by the high electrical conductivity metal strip of tetragonal shape is not less than a 1/150 fraction and not more than a 1/2 fraction of a resistivity of the resistor body.

12. (Twice Amended) A low resistance value resistor according to claim 7, wherein said resistor body is trimmed to adjust a resistance value by removing a portion thereof along a direction of current flow between the electrodes ~~without forming any cutout~~.

14. (Twice Amended) A low resistance value resistor according to claim 1 ~~13~~, wherein ~~comprising~~ an insulation layer ~~which~~ covers a portion of said surface of the resistor body between said electrodes.

15. (Twice Amended) A low resistance value resistor according to claim 14, wherein another insulation layer is further provided for covering another surface of said resistor body opposite to the surface of the resistor body between said electrodes ~~thereof~~.

16. (Amended) A low resistance value resistor according to claim 14 ~~13~~, wherein

said insulation layer comprises an insulative material, which is coated on specific locations of the resistor body.

17. (Amended) A low resistance value resistor according to claim 14 ~~13~~, wherein said insulation layer comprises an insulative material, which is adhered on specific locations of the resistor body.

18. (Amended) A low resistance value resistor according to claim 14 ~~13~~, wherein said insulation layer comprises one of: an epoxy resin, an acrylic resin, a fluorine resin, a phenol resin, a silicone resin, and a polyimide resin.

20. (Amended) A low resistance value resistor according to claim 1 ~~13~~, wherein said electrode comprises copper or an alloy containing copper.